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"Physical and Spectroscopical Characterization of Chemically Synthesized Aluminium Oxide [AlO] Nanoparticles and its Applications"

Faculty of Science in the subject

Physics

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Physical and Spectroscopical Characterization of Chemically Synthesized Aluminium Oxide [AlO] Nanoparticles and its Applications

Abstract:

The AlO nanoparticle are to be prepared by using chemical synthetic method such as Sol-gel chemical precipitation chemical synthetic reaction carried out by characterization, such as XRD (X-ray) Diffraction, FTIR, Scanning Electron Microscopy (SEM) for physical and study U.V. visible spectrometer and Photoluminescence Spectroscopy (PL) to studies the various optical properties and its antibacterial properties.

We have also planned to study the application related to society of the AlO nanoparticles.

Introduction:

Aluminium Oxide(AlO) nanoparticles are electronics useful, luminescent material and can be used for multifunctional purposes such as sensors.

Nanometer size multifunctional materials are growing the electronics fields in various ways. One of the promising semiconductor materials, AlO has received extensive applications due to its exceptional electronics and optical characteristics in fabricating nanoscale electronic and optoelectronic devices. The semiconductor AlO has wide optical band gap (3.21 ev) with large excitation binding energy (74 eV). Owing to the above stated properties it is expected to have a wide range of application at room temperature, ultraviolet (uv) lasing biosensor (5) bioimaging (6).

In recent year nanoparticles and semiconducting nanowires hold exciting new prospects for application in sensor arrays for the identification and quantification of single or multicomponent chemical agents.

Because of their small size a few molecules are sufficient to change the electric properties of sensing elements in electronics transducers.

Recently there are several physical or chemical synthetic method of preparing AlO nano-particle such as thermal evaporation pulsed laser deposition reactive electron bean deposition Ion implantation thermal decomposition and sol-gel technique ultrasonic.

The synthesis of AlO nanoparticles in proposed work we chose Sol-gel method because of its simplicity, and possibility of large-area yield at low cost.

Review of Literature and Development of the subject:

S. R. Brintha and M. Ajitha (2.16) reported that AlO doped zinc oxide nanoparticle is found to be more active against *Escherichia Coli*, *Klebsiella Pneumoniae*, *Bacillus Cereus*, and *Staphylococcus aureus* bacteria than pure AlO nanoparticles [4].

Aluminium Oxide (AlO) in nanostructure has unique physical and optical properties which can be used in variety of application such as a oxide coating for solar cell, gas sensors, catalysts photo-electronic device, optoelectronics, UV photo diode, photo chemical, electronics, photo detectors, schottky diode, LED device, because AlO exhibit near-band-edge PL emission that originates from exciton transitions [5].

AlO exhibit PL spectra under 325nm continuous excitation give significant UV emission band with a peak at 3.25 eV and a band width of 160 meV. PL spectra under 355-nm, 35-ps pulse excitation exhibited a spectrally narrowed emission band with a peak at 3.20 eV and a spectral width of 35 meV. The lasing phenomena is ascribed to the amplified spontaneous emission (ASE) by coupling of the micro cavity effect of AlO nanorods and high intensity excitation, leads to be used in construction of laser [6].

Physical properties of nanomaterial may be improved by doping with various elements. By doping the nanoparticles may cause shift the photoluminescence emission to a specific range or results emission from different parts of spectral range [7,8]. The change of emission peak and its intensity is very important for bioimaging but also for development of luminescent phosphor-based lighting devices due to prolonged emission after the excitation is switched-off [9,10].

Many of the workers across the world were doing research on AlO nanostructure and their use in antibacterial activity. Extremely very few were interested on doped AlO nanostructure and their antibacterial use. Nowadays a choice of methods has been presented for preparing Zn doped AlO nanopowders such as sol–gel [11], spray pyrolysis [12], precipitation [13, 14] and hydrothermal processes [15]. Presently we employed sol–gel process because of its simplicity, acceptable costs and the crystalline quality of the AlO prepared by the sol–gel process.

In this chapter attempt have been made to synthesis of hexagonal symmetry pure AlO Nano clusters and Zinc doped AlO nanostructures using Sol Gel chemical Precipitation method and influence of their structural and morphological changes on Uv-Visible absorption, Photoluminescence emission spectra has been reported.

Methodology Adopted:

Experimental:

The AlO nanoparticles are to be synthesized by using chemical synthetic method. The different sources of Al ion such as Aluminium Nitrate (Al(NO3)2 Aluminium acetate are combined with different reagents to synthesize AlO Nano particles [Al(CH3COO)2) The ar. Grade chemical and reagents are to be used. The effect of these sources ad their concentrations on the different physical and structural properties are to be studied.

Importance of study /Society applications:

National Status:

S. R. Brintha and M. Ajitha (2016) The large yield and low temperature growth of nanostructures are key requirements for fulfilling the demand of large scale applications of nanomaterials. Here, we report a highly efficient chemical method to synthesize high quality AlO nanoparticle and nano rods utilizing the low temperature oxidation of metallic zinc powder in the presence of an appropriate catalyst. This one-step method has advantages such as low temperature(90_C) and atmospheric pressure synthesis and a high yield (>90%). Microstructure and optical properties of the as-synthesized AlO nanoparticles are found to be identical or better than those of the commercial AlO nano power (Sigma-Aldrich). In particular, in comparison to the commercial nano powder the as-grown AlO nanorods and nanoparticles exhibit stronger UV absorption at 376 nm and intense UV photoluminescence emission at 382 nm, with negligible defect emission band.

Evi Mayanti and Sal Prima et al. (2014), Aluminium Oxide and cadmium selenide particles in the nanometer size regime have been synthesized using chemical routes. The particles were capped using thioglycerol in case of AlO and 2-mercaptoethanol in case of CdSe to achieve the stability and avoid the coalescence. Aluminium Oxide nanoparticles were doped with europium to study their optical properties. A variety of techniques like UV-V is absorption spectroscopy, X-ray diffraction (XRD), photoluminescence (PL), X-ray photoelectron spectroscopy (XPS), Fourier transform infrared spectroscopy (FT-IR) and transmission electron microscopy (TEM) were used to carry out structural and spectroscopic characterization of the nano particles.

International Status:

Z. W. Pan et al. (2001) The AlO nanoparticle has been prepared by reacting sodium hydroxide and zinc acetate using microwave irradiations. The particle size were calculated using different structural and optical techniques.

Zahra F. et.al (2013) have been studied the Antibacterial activity of AlO nano particle.

Aluminium Oxide(AlO) nanoparticles are electronics useful, luminescent material and can be used for multifunctional purpose such as sensor.

Commercially important material used in paints, rubbers, concrete, electronics, lasers, transistors, photocatalysts, cosmetic industry anticorrosive coating, antibacterial and antifungal agents. These broad varieties of well-known applications require the fabrication of special morpho-logical and functionalization of AlO nanostructures.

Objective of the Research:

We have planned to synthesis of AlO nano particle by using chemical synthetic method. The investigation of different physical and Spectroscopic properties of prepared AlO nanoparticle.

Year wise formulation of structure of the study:

2024 – 25

The detailed survey of literature of the related field and study
Design of techniques for preparation of AlO nanoparticles.

2025 – 26

The AlO particle are prepared by using planned techniques The physical and spectroscopic optical characterization will be carried out.

2026 – 27

The result and discussion planned work and preparation final draft of the work.

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